UNIVERSITI SAINS MALAYSIA

First Semester Examination

2014/2015 Academic Session

December 2014/January 2015

EEE 228 – SIGNAL AND SYSTEM
[ISYARAT DAN SISTEM]

Duration : 3 hours

[Masa : 3 jam]

Please check that this examination paper consists of **EIGHT (8)** pages and Appendices **TWELVE (12)** pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **LAPAN (8)** mukasurat dan Lampiran **DUA BELAS (12)** muka surat bercetak sebelum anda memulakan peperiksaan ini.]*

Instructions: This question paper consists of SIX (6) questions. Answer **FIVE (5)** questions. All questions carry the same marks.
[***Arahan:*** *Kertas soalan ini mengandungi ENAM (6) soalan. Jawab **LIMA (5)** soalan. Semua soalan membawa jumlah markah yang sama.]*

Answer to any question must start on a new page.
[Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru]

In the event of any discrepancies, the English version shall be used.
[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

1. (a) Briefly explain:-
Secara ringkas, terangkan:-

i) Linear interpolation of signals
Interpolasi lelurus isyarat

ii) Frequency domain multiplexing
Pembahagian frekuensi multiplex

(30 marks/*markah*)

b) A signal is shown in Figure 1.
Satu isyarat ditunjukkan dalam Rajah 1.

i) Give the mathematical expression for the signal.
Berikan ungkapan matematik bagi isyarat tersebut.

ii) Write the equation for this signal in terms of unit functions only.
Tuliskan persamaan bagi isyarat ini dalam sebutan fungsi unit sahaja.

iii) Sketch $y(t) = 2tx(-t + 1)$.
Lakarkan $y(t) = 2tx(-t + 1)$.

(70 marks/*markah*)

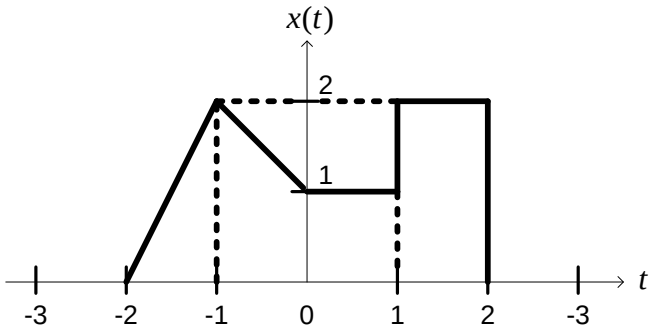


Figure 1
Rajah 1

2. (a) A discrete signal is given by the equation:-

Satu isyarat diskret masa diberikan oleh persamaan:-

$$p[k] = 2\{-u[k+3] + u[k+1]\} - 3u[k-3] + r[k+1] - r[k] + r[k-1] - r[k-3]$$

Sketch this signal for $-4 \leq \mathrm{k} \leq 4$.

Lakarkan isyarat ini untuk $-4 \leq k \leq 4$.

(30 marks/*markah*)

(b) Using the sliding tape method, show that:-

Menggunakan kaedah pita menggelungsur, tunjukkan bahawa:-

(i) $u[k] * u[k] = (k+1)u[k]$

(ii) $(u[k] - u[k-m]) * u[k] = (k+1)u[k] - (k-m+1)u[k-m]$

(c) Find and sketch, $\mathrm{f[k]} * \mathrm{g[k]}$, for the signals shown in Figure 2.

Cari dan lakar, $f[k] * g[k]$*, bagi isyarat-isyarat ditunjukkan dalam Rajah 2.*

(70 marks/*markah*)

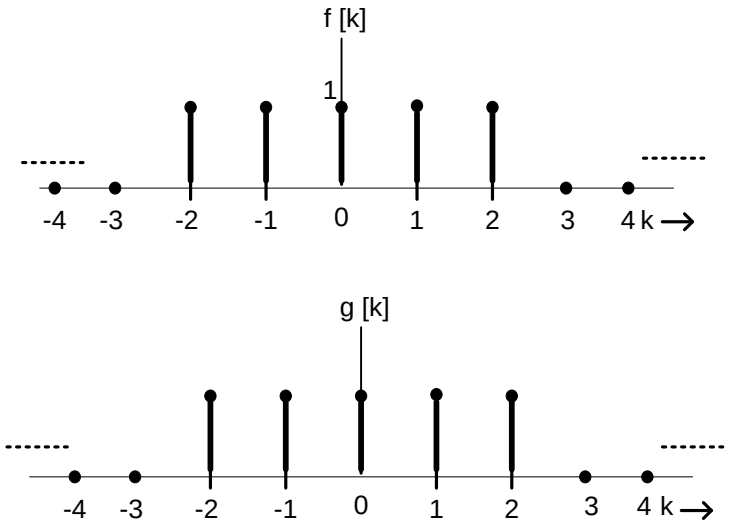


Figure 2

Rajah 2

3. (a) Obtain the differential equation for the system shown in Figure 3 (a).
Dapatkan persamaan kebezaan bagi sistem ditunjukkan dalam Rajah 3 (a).

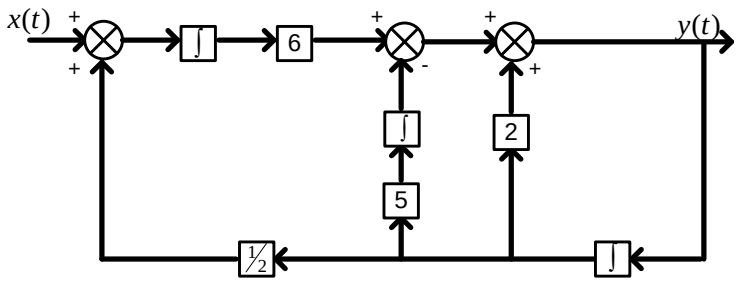
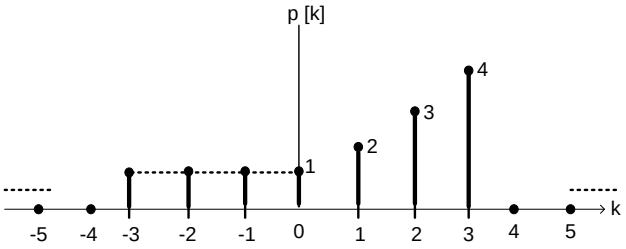


Figure 3 (a)
Rajah 3 (a)

(30 marks/*markah*)

(b) Sketch the even and odd components of the signals shown in Figure 3 (b).
Lakarkan komponen ganjil dan genap isyarat-isyarat ditunjukkan dalam Rajah 3 (b).

i)



ii)

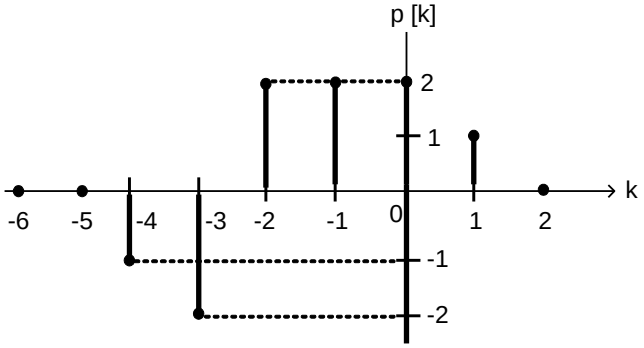


Figure 3 (b)
Rajah 3 (b)

(70 marks/*markah*)

4. (a) Using the definition of Fourier Transform, derive the Fourier Transform of the signal in Figure 4(a) and Figure 4(b).

Dengan menggunakan definisi Jelmaan Fourier, cari Jelmaan Fourier bagi isyarat dalam Rajah 4(a) dan Rajah 4(b).

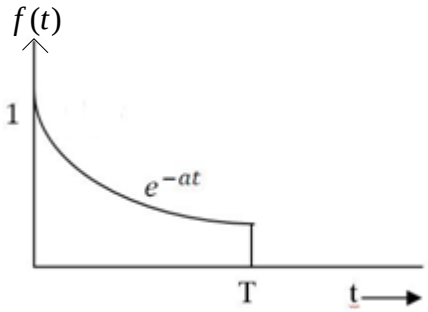


Figure 4(a)
Rajah 4(a)

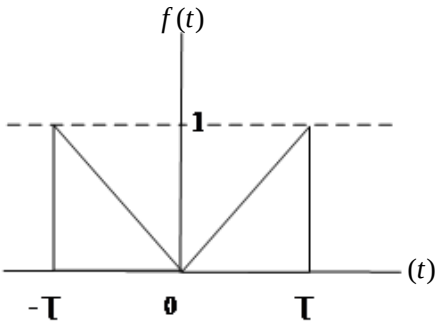


Figure 4(b)
Rajah 4(b)

(30 marks/*markah*)

(b) Using Fourier Transform, solve the following convolution.

Dengan menggunakan Jelmaan Fourier, selesaikan pelingkaran berikut.

$sinc(t) * sinc(t)$

(25 marks/markah)

(c) i. Explain briefly what are sampling theorem and Nyquist rate.

Terangkan secara ringkas apakah teori persampelan dan kadar Nyquist.

(15 marks/*markah*)

ii. The signal *x(t)* with Fourier Transform $X(\omega) = tri\left(\frac{\omega}{\omega_c}\right)$ is sampled by three different impulse trains with periods $T_1 = \frac{\pi}{\omega_C}$, $T_2 = \frac{\pi}{2\omega_C}$ and $T_3 = \frac{2\pi}{\omega_C}$.

Sketch the sampled spectrum for each case. Which case or cases experience aliasing?

Isyarat x(t) dengan Jelmaan Fourier $X(\omega) = tri\left(\frac{\omega}{\omega_c}\right)$ *disampelkan dengan tiga jujukan impuls dengan tempoh masa* $T_1 = \frac{\pi}{\omega_C}$, $T_2 = \frac{\pi}{2\omega_C}$ *and* $T_3 = \frac{2\pi}{\omega_C}$.

Lakarkan spektrum tersampel bagi setiap kes. Kes yang manakah melalui 'aliasing'?

(30 marks/*markah*)

5. (a) Using Z-transform, determine the response of the LTI system with impulse response, $h[n] = \{1, -1, 1\}$, for an input $x[n] = \{-2, 3, 1\}$.

Dengan menggunakan Jelmaan-Z, tentukan sambutan sistem masa lelurus tak varian bagi sambutan impuls, $h[n] = \{1, -1, 1\}$, *bagi masukan,* $x[n] = \{-2, 3, 1\}$.

(30 marks/*markah*)

(b) Given $f[n] = a^n u[n]$, find the Z-transforms of the following:

Diberi $f[n] = a^n u[n]$ *, cari jelmaan Z bagi yang berikut:*

i. $f[\frac{n}{7}]$

ii. $f[n-7]u[n-7]$

(30 marks/*markah*)

(c) Using partial fraction, find the inverse Z-transform of

Dengan menggunakan pecahan separa, cari Jelmaan Z- songsang bagi

$$X(Z) = \frac{1 + Z^{-1} + 2Z^{-2}}{\left(1 - \frac{1}{2}Z^{-1}\right)\left(1 - \frac{1}{3}Z^{-1}\right)\left(1 - \frac{1}{4}Z^{-1}\right)}$$

where $|Z|> 1/2$

di mana $|Z|> 1/2$

(40 marks/*markah*)

6. (a) Using appropriate illustration, diagram and equations, describe:

Dengan menggunakan rajah, diagram dan persamaan-persamaan yang bersesuaian, terangkan:

i. The modulation and demodulation process
Proses modulasi dan demodulasi

ii. The importance of modulation process in data transmission
Kepentingan proses modulasi dalam proses transmisi data

(30 marks/*markah*)

(b) Solve
Selesaikan
$4y[k+2] + 4y[k+1] + y[k] = f[k+1]$
where
di mana
$y[-1] = 0; y[-2] = 1; f[k] = u[k]$

(35 marks/*markah*)

(c) Find the 4 point DFT and verify the IDFT of a 4 point signal specified by the sequence 1, 2, 2, 1 starting at k=0.

Cari 4 titik DFT dan tentusahkan IDFT bagi 4 titik isyarat yang dinyatakan dalam jujukan 1, 2, 2, 1 bermula dari k=0.

Given:

Diberi

$$F_r = \sum_{k=0}^{N-1} f_k e^{-jr\Omega k}$$

$$f_k = \frac{1}{N} \sum_{r=0}^{N-1} F_r e^{jr\Omega k}$$

(35 marks/*markah*)

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